



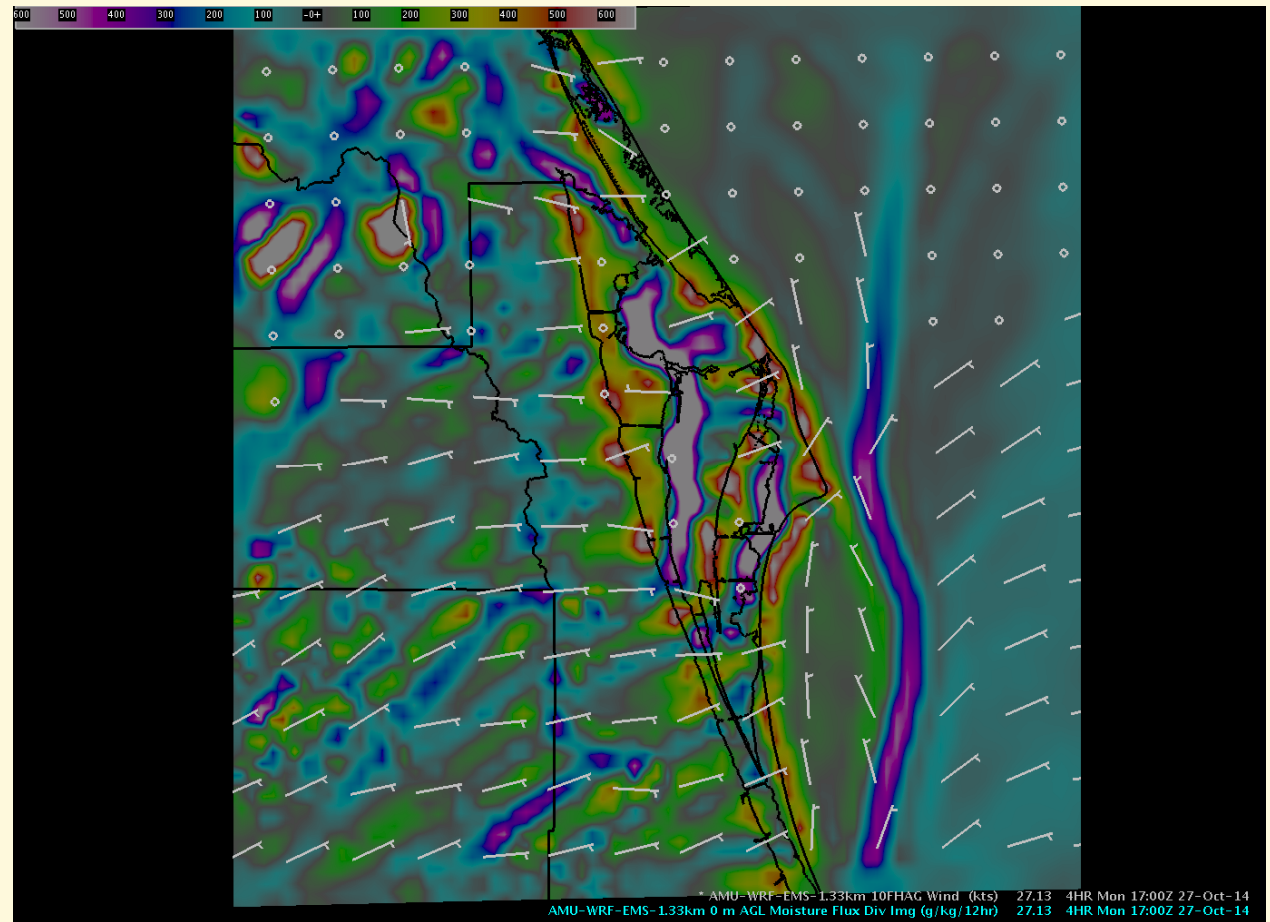
High-Resolution Mesoscale Model Setup for the Eastern Range and Wallops Flight Facility

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Outline

- Project goal
- Background
- Modeling system
- Data and model configuration
- Model validation
- Summary





Project Goal



- Mesoscale conditions affect space launch, landing, and ground processing at the Eastern Range (ER) and Wallops Flight Facility (WFF)
- Need high resolution mesoscale model output to forecast unique weather phenomena at each range
- Provide a properly tuned data assimilation (DA)/numerical forecast model optimized for the ER and WFF



Background

- Phase I work
 - Compared model forecasts while varying the dynamical core, grid spacing, domain size, and forecast length
 - Varied model physics to determine which produced best forecasts
 - Ran test cases in the warm and cool seasons at the ER and for the spring and fall seasons at WFF
 - Results: Advanced Research Weather and Research Forecasting (WRF ARW) model, Lin microphysical scheme, Ferrier microphysical scheme (WFF only), and Yonsei University (YSU) planetary boundary layer (PBL) scheme

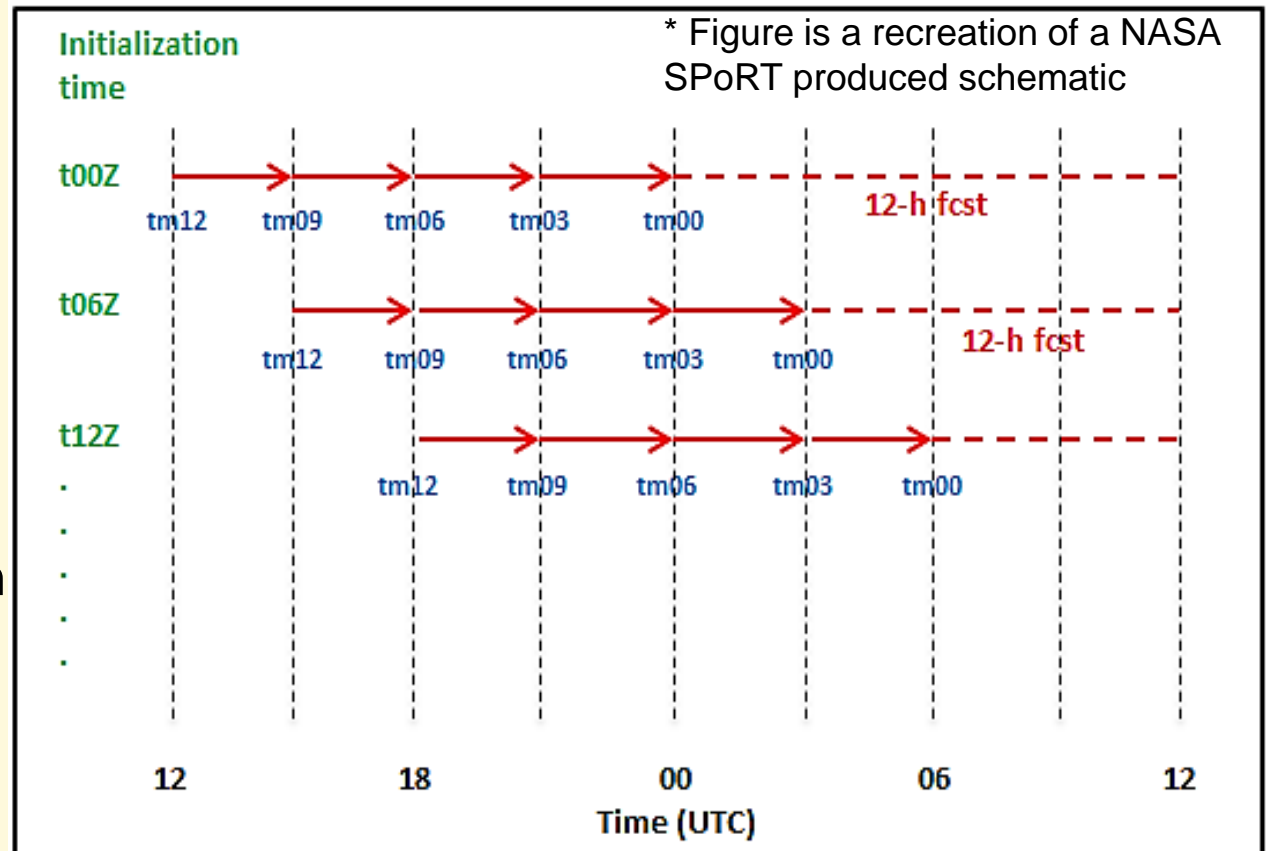




Cycled DA/NWP System

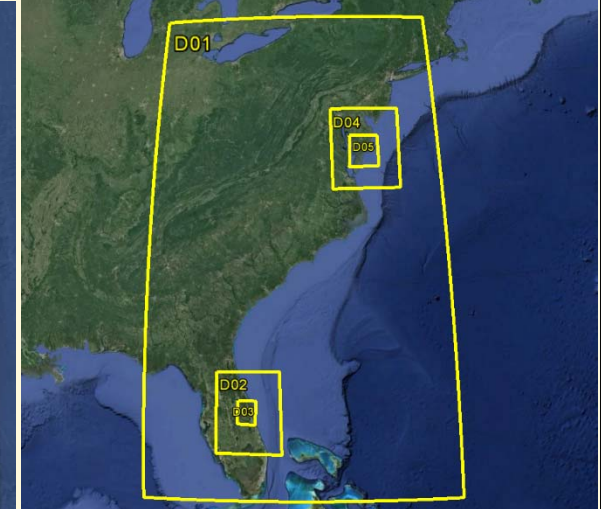
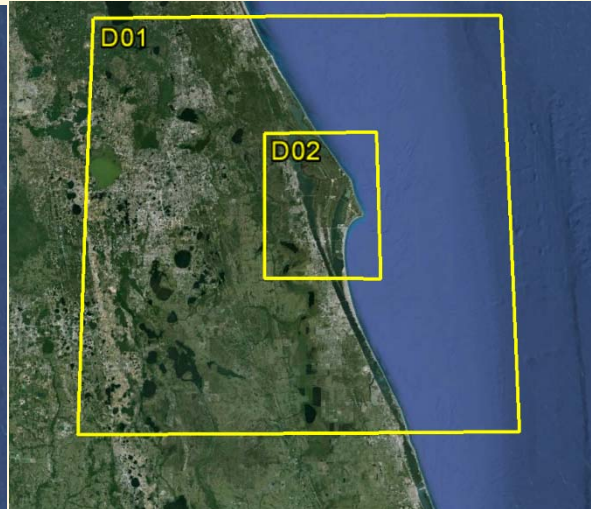
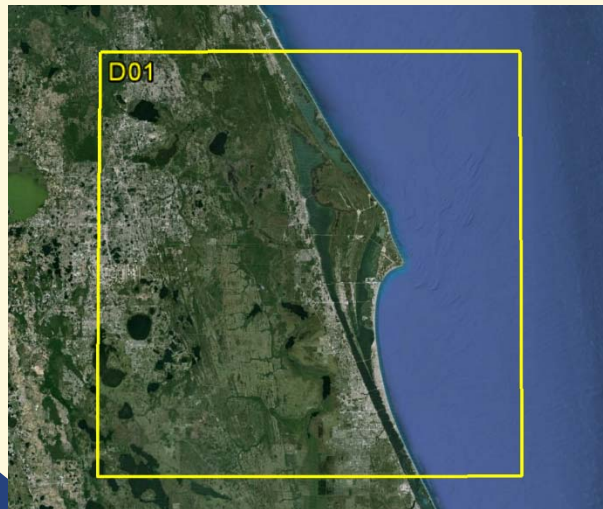
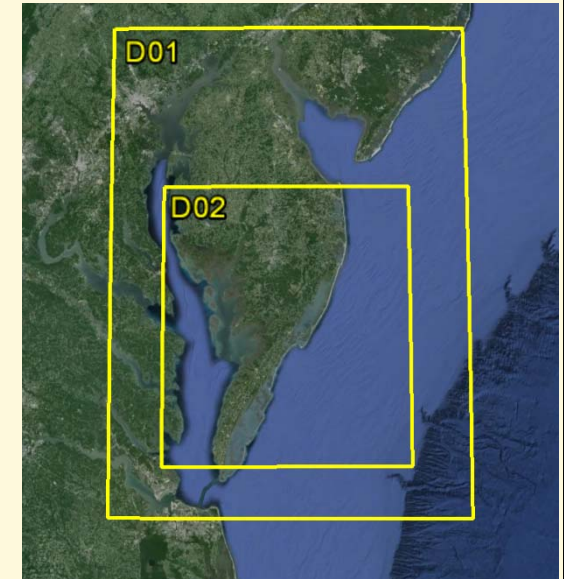


- NCEP's Gridpoint Statistical Interpolation (GSI)/WRF
- NASA Short-term Prediction Research and Transition Center (SPoRT) Perl scripts
 - Easy-to-use interface for users to execute GSI/WRF
 - Cycled GSI system similar to operational North American Mesoscale (NAM) model



Data and Model Configuration

- Test cases:
 - 1 km single domain (ER)
 - 2 km outer, 0.67 km inner domain (ER)
 - 9 km outer, 3 km middle, 1 km inner domain (ER & WFF)
 - 4 km outer, 1.33 km inner domain (WFF)





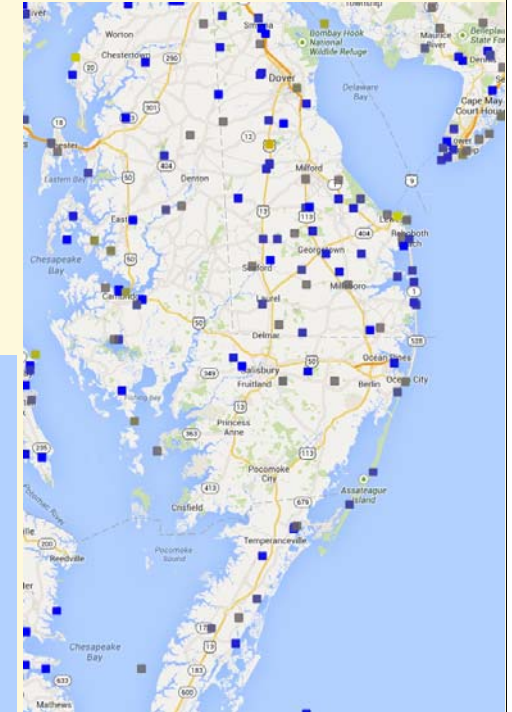
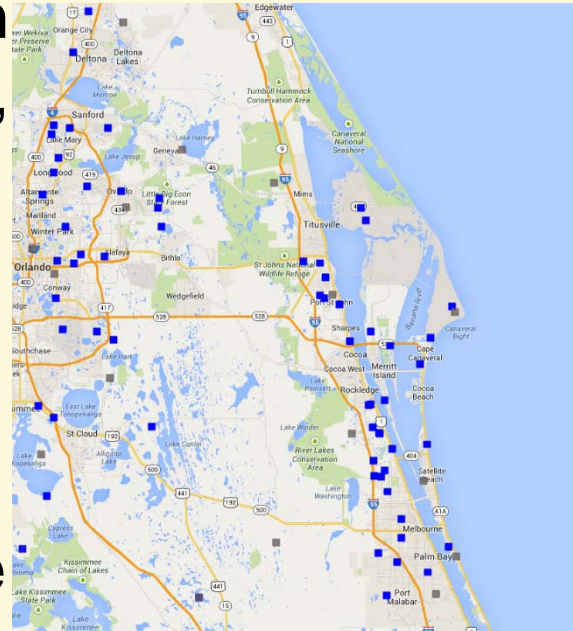
Data and Model Configuration, cont.



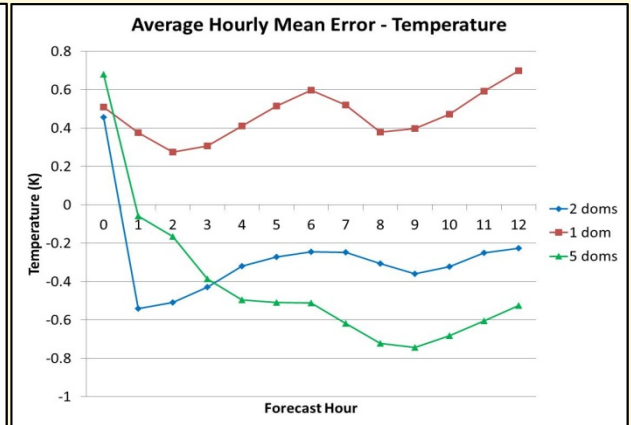
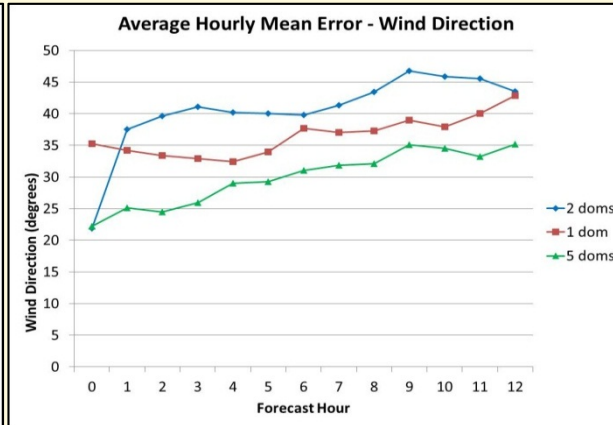
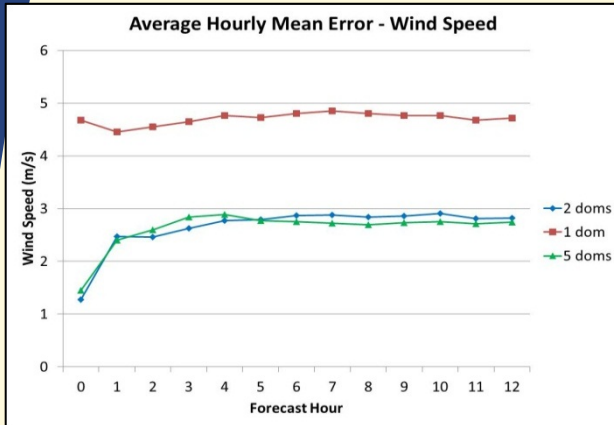
- WRF Initialization:
 - 35 irregularly spaced, vertical sigma levels
 - 12-h forecast run four times per day at 00, 06, 12, and 18 Z
 - 13-km Rapid Refresh (RAP) model for BCs and as the background model first-guess field
 - SPoRT Land Information System (LIS) data
 - Sea surface temperature (SST) data from both NCEP's Real-time Global SSTs and the SPoRT 2-km SST composites
 - Initial conditions created using GSI/WRF scripts
 - Conventional/radar/satellite observations from NCEP PrepBUFR files
 - Period of record: 12Z 27 Aug 2013 to 06Z 10 Nov 2013

Model Validation

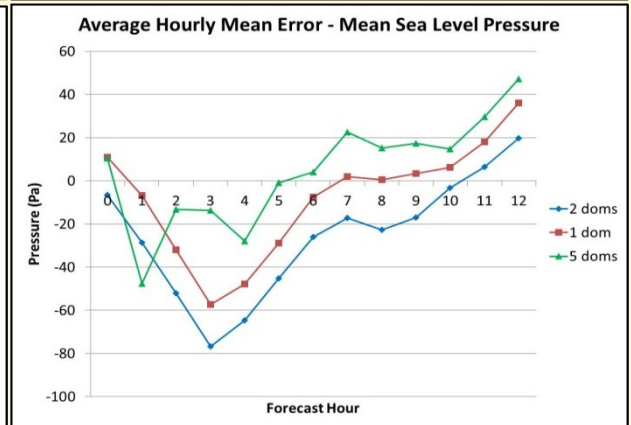
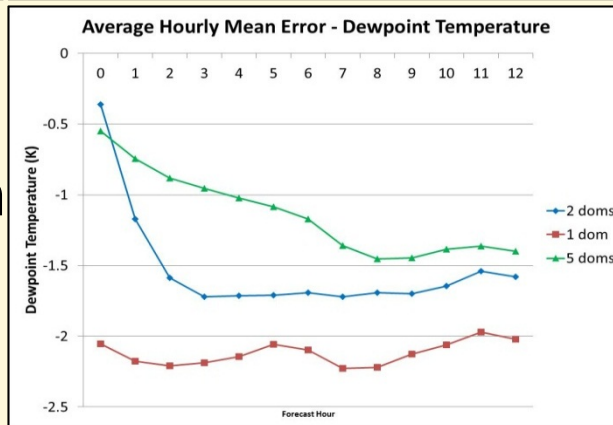
- Validated forecasts with local METAR and mesonet data
- Used Model Evaluation Tools (MET)
 - Point-Stat
 - MODE
- Verified surface forecasts using Mean Error (ME), Root Mean Square Error (RMSE), Pearson Correlation Coefficient (PCC)
- Verified precipitation using centroid distance, area ratio, and total interest value



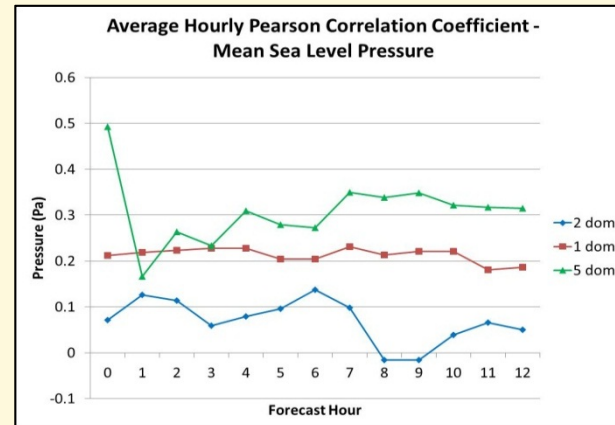
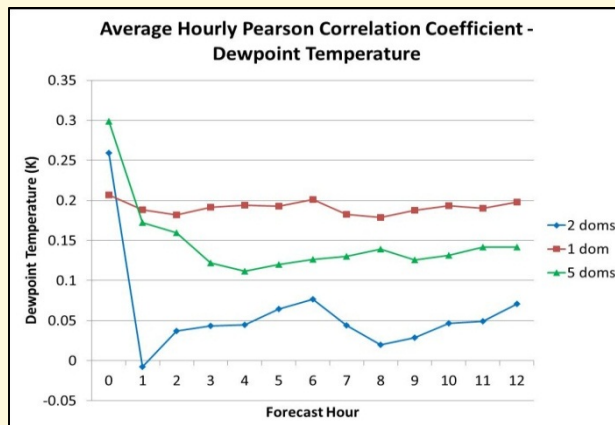
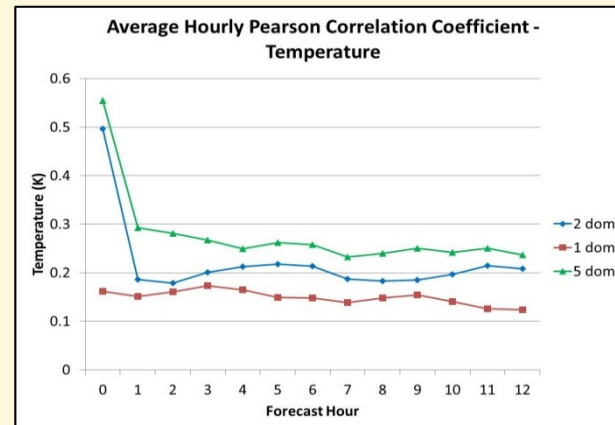
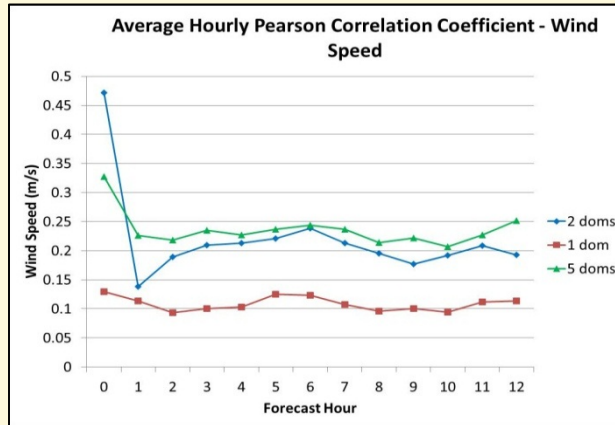
ER Results: Surface Forecasts



- Overall, triple-nest configuration (5 doms) performed best, followed by nested domain (2 doms), and single domain (1 dom) for ME
- Similar results for RMSE

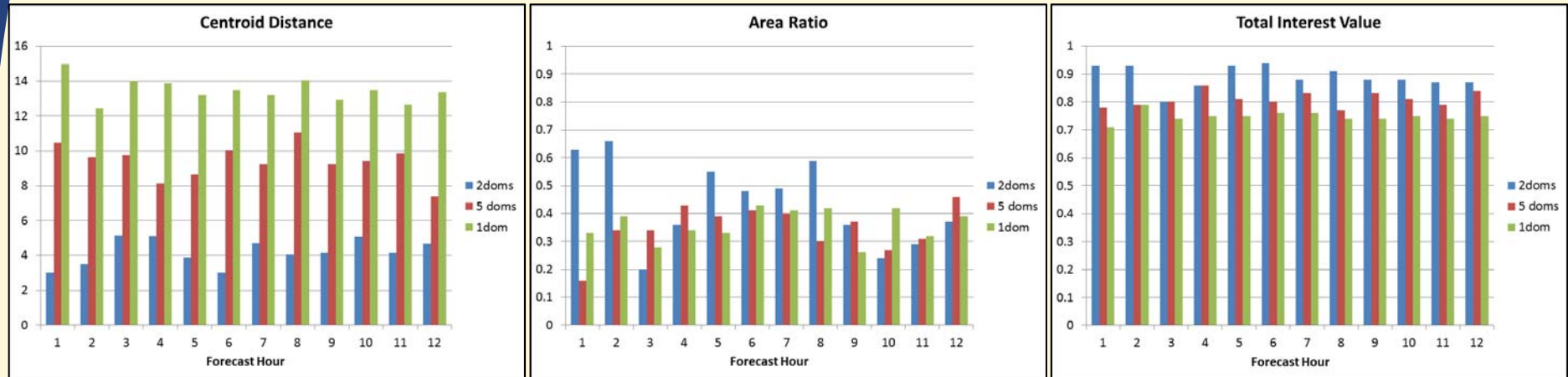


ER Results: Surface Forecasts



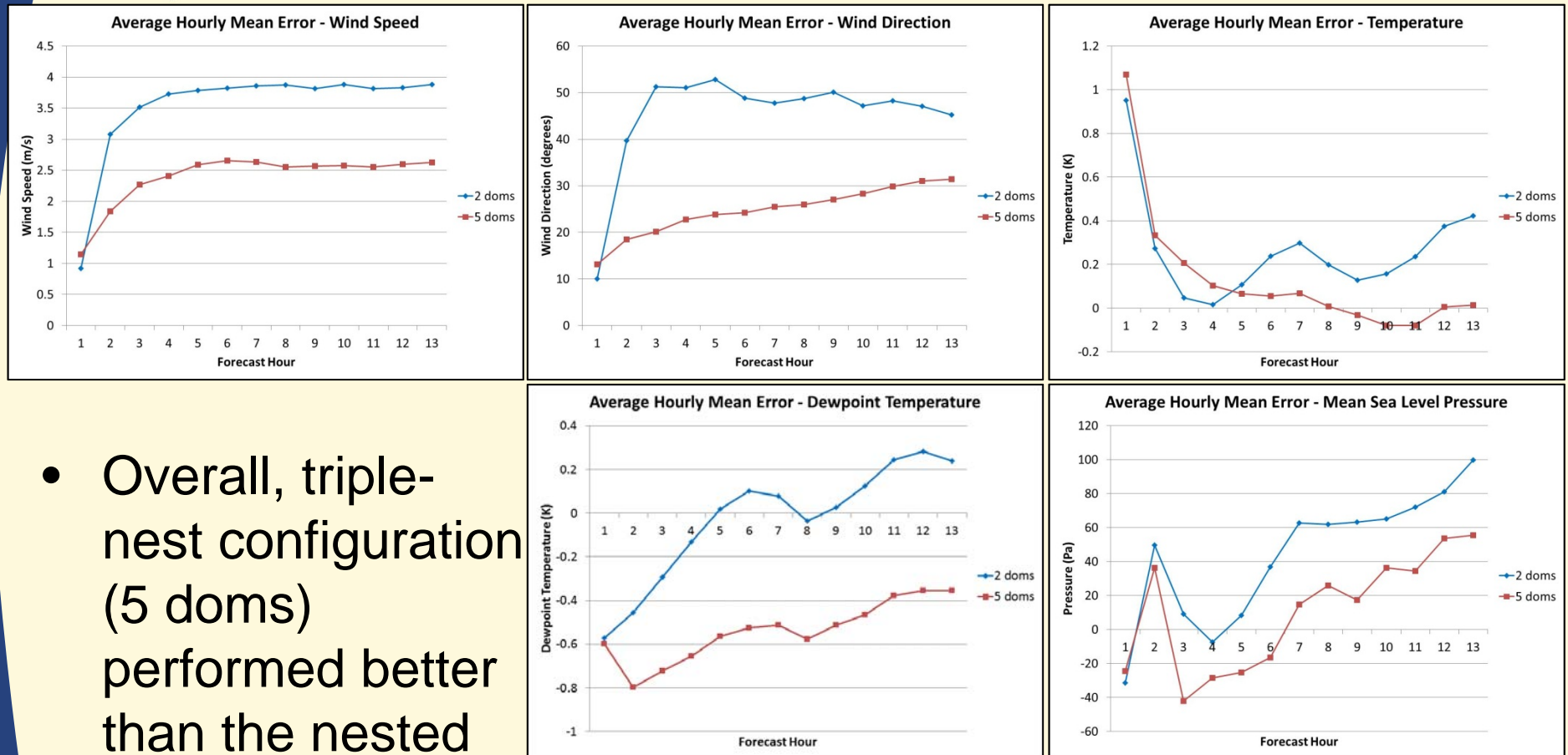
- Overall, triple-nested configuration performed best, followed by single domain, and nested domain for PCC

ER Results: Precipitation



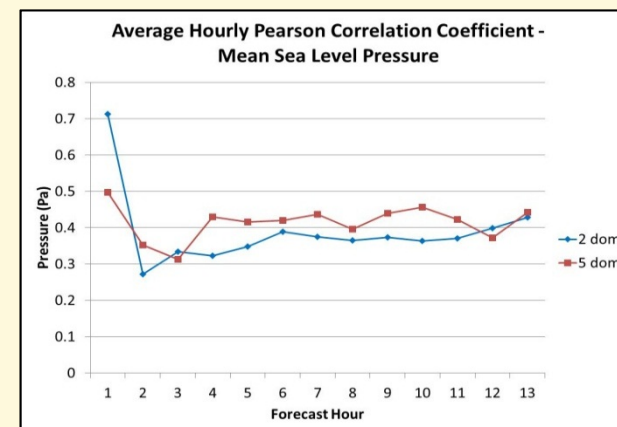
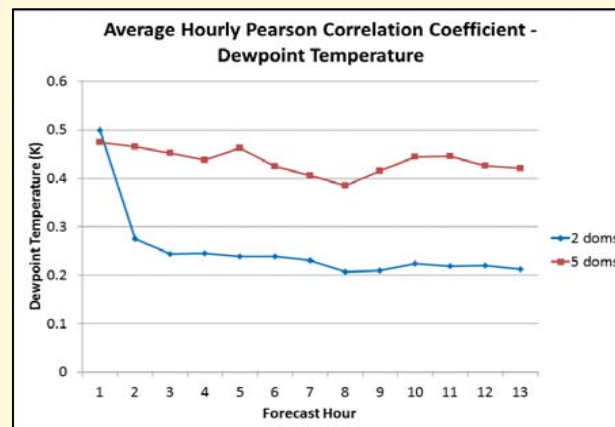
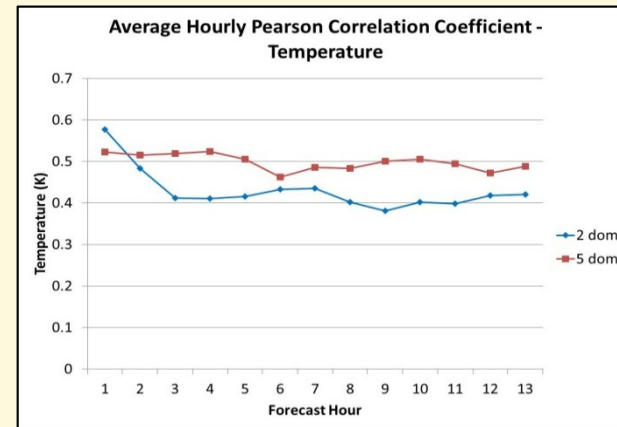
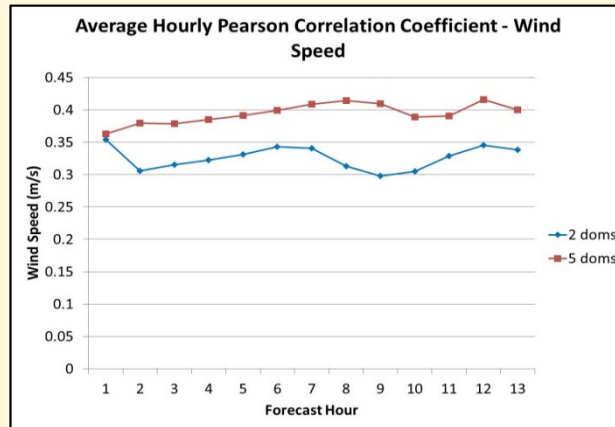
- Compared 1-hr forecast to observed accumulated rainfall using NCEP Stage-IV analysis data for entire POR
- Overall, the nested domain outperformed both triple-nest and single domain configurations

WFF Results: Surface Forecasts



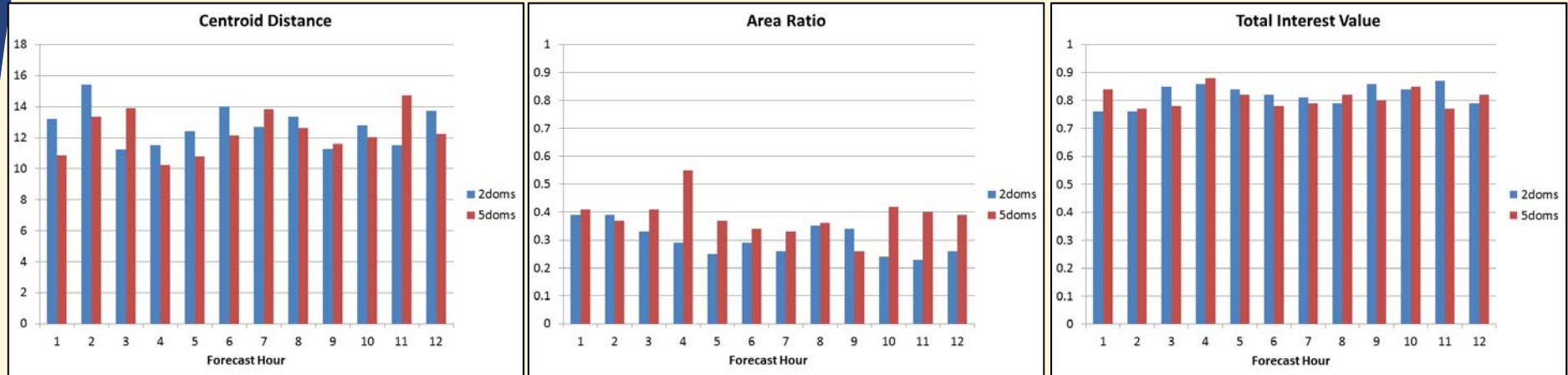
- Overall, triple-nest configuration (5 doms) performed better than the nested domain (2 doms) for ME
- Similar results for RMSE

WFF Results: Surface Forecasts



- Overall, triple-nested configuration performed best, followed by single domain, and nested domain for PCC

WFF Results: Precipitation



- Compared 1-hr forecast to observed accumulated rainfall using NCEP Stage-IV analysis data for entire POR
- Overall, the nested domain outperformed both triple-nest and single domain configurations



Summary



- Ran GSI/WRF model system for each range while varying grid resolutions on which DA was run and varying nesting configurations to determine the impact on model skill
- In general for both the ER and WFF, the triple-nest configuration outperformed the other configurations
 - However, nested configuration did the best in predicting precipitation for the ER
- Recommendation:
 - Either nested or triple-nest configuration is optimal for the ER
 - Triple-nest configuration is optimal for WFF
- Continuing to fine-tune modeling system for both ranges